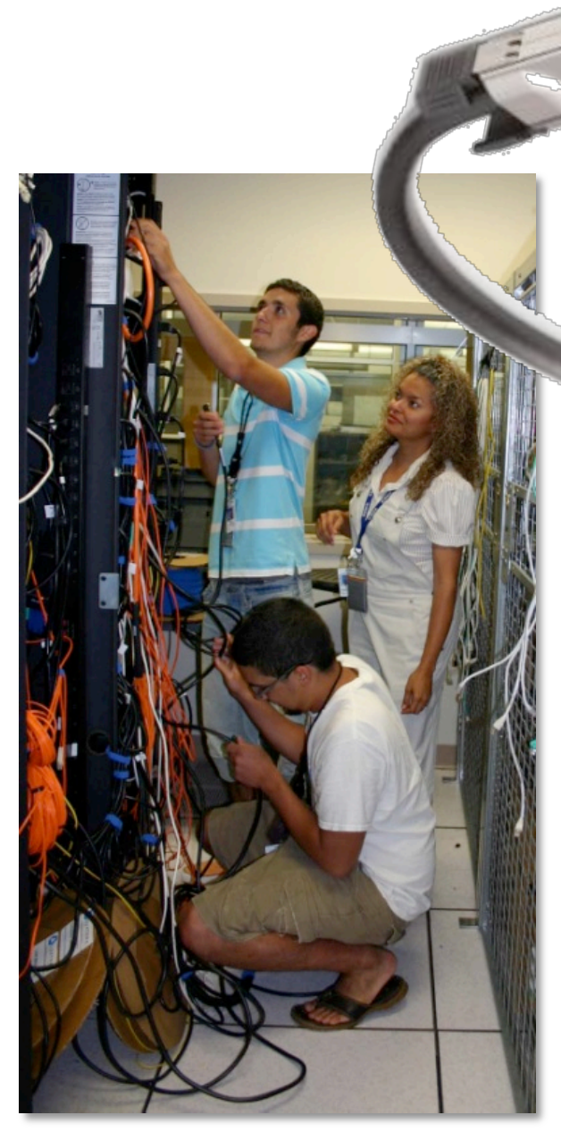
Performance Analysis and Evaluation of LANL's PaScalBB IO nodes using PCIe Gen 2.0 Quad-Data-Rate Infiniband and Multiple 10-Gigabit Ethernets

Abstract

I/O nodes are the key components used in LANL's PaScalBB (Parallel Scalable Back Bone) infrastructure to carry data traffic between backend compute nodes and global scratch file systems. Combining Infiniband Quad-Data Rate (QDR) HCA with multiple 10-Gigabit IPC Ethernet links can potentially alleviate currently existing I/O traffic bottlenecks. In this experiment we set up a small-scale PaScalBB test bed and conduct a sequence of I/O node performance tests. The purpose of these experiments is to find an enhanced network configuration that can be applied to LANL's future supercomputer utilizing PaScalBB architecture.



Checking the cluster connections

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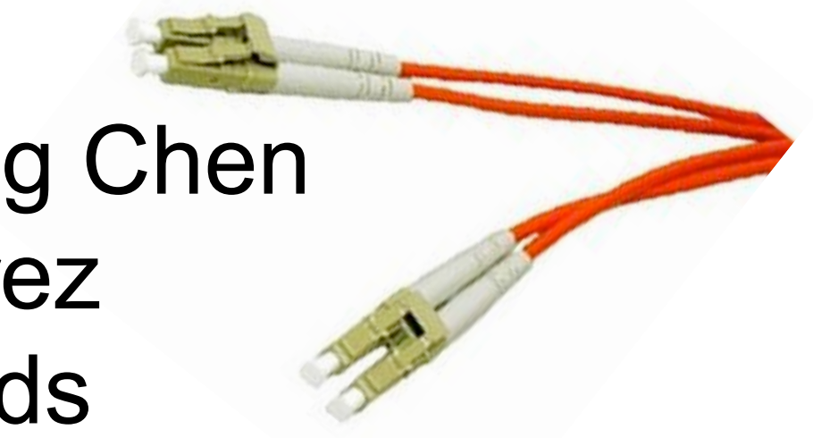
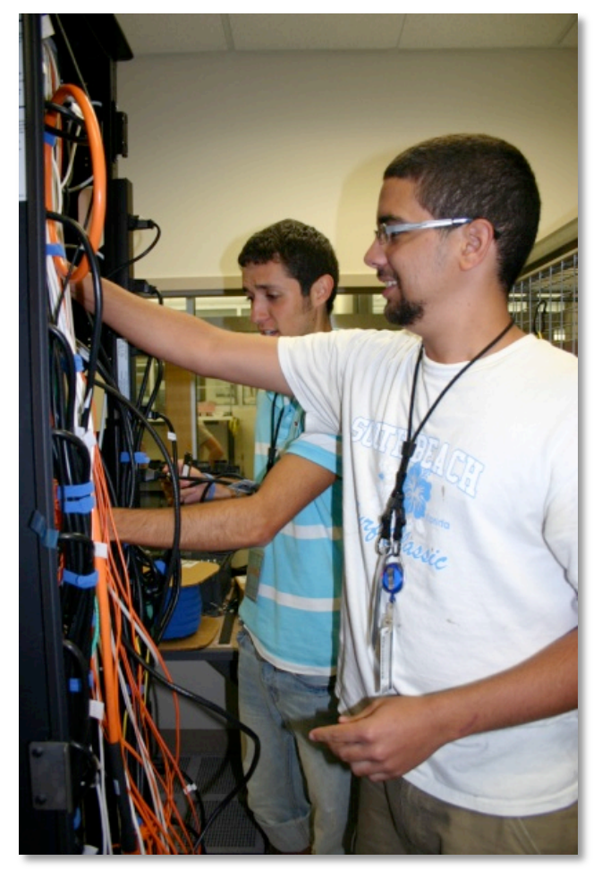


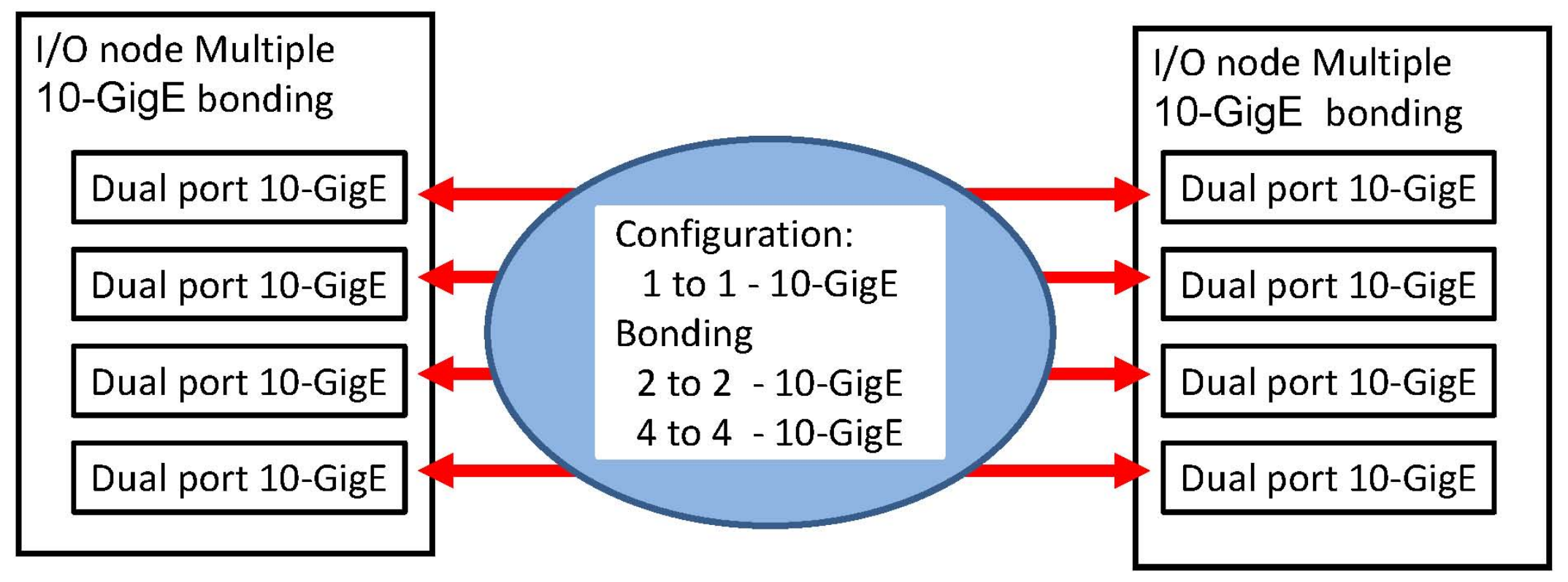


Doing the IB/QDR and 10-Gigabit bonding

ConnectX EN
Single/DualPort 10-Gigabit Ethernet Adapters with PCI Express

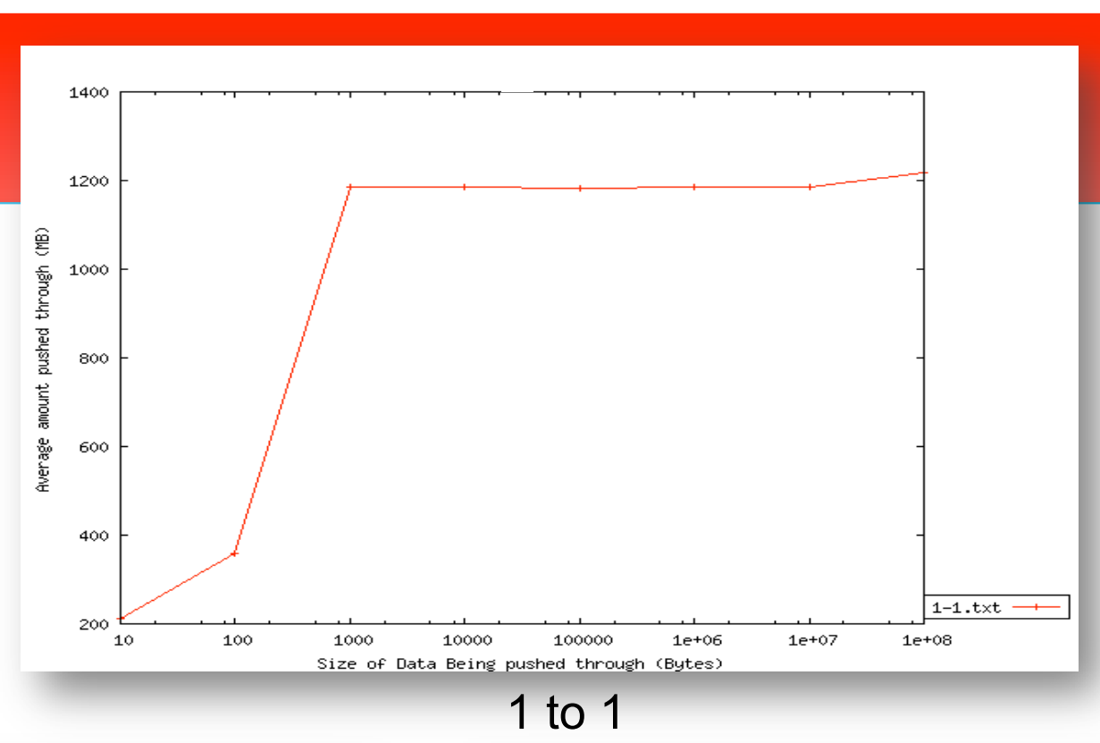
Testing the bonding

Performance Back-to-Back Multiple 10-Gigabit bonding testing

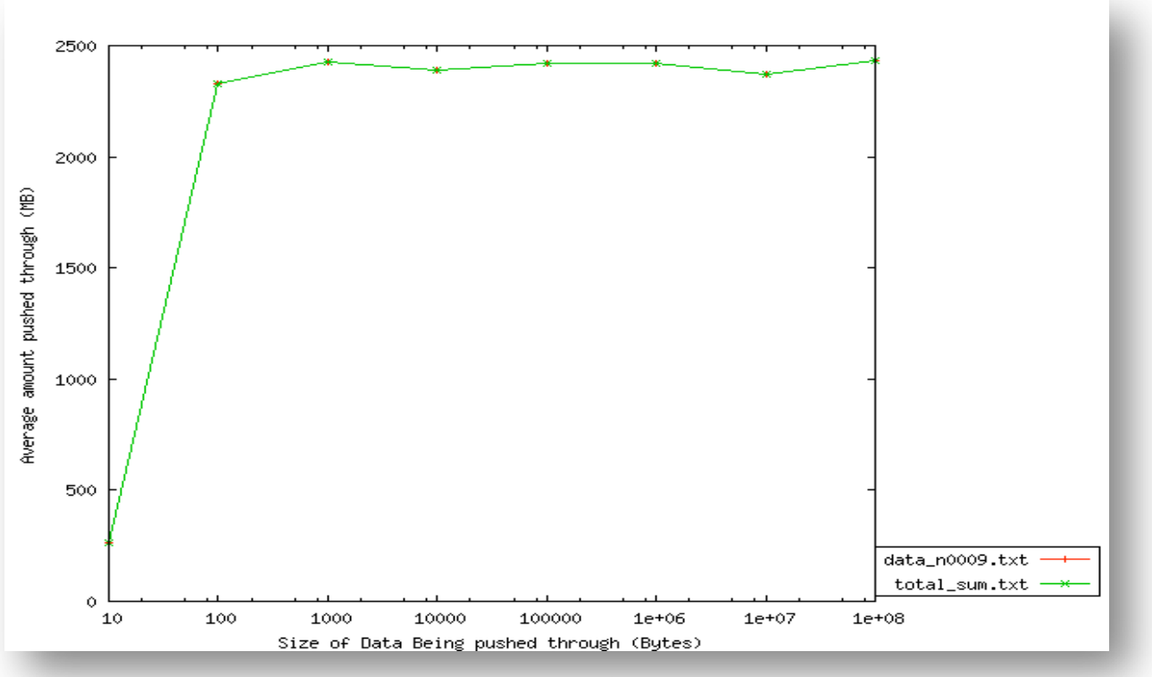


Arista 10-Gigabit transceivers.
Set bonding Mode 0 and Mode 5 to get load balancing.
Increased TCP buffer size, read and write memory to 16.7 MB.
Set the TCP timestamp and TCP sack to 1
The changes we made to the TCP stack increased the bandwidth performance by 10x from the TCP default setting. By default the setting are set too small.

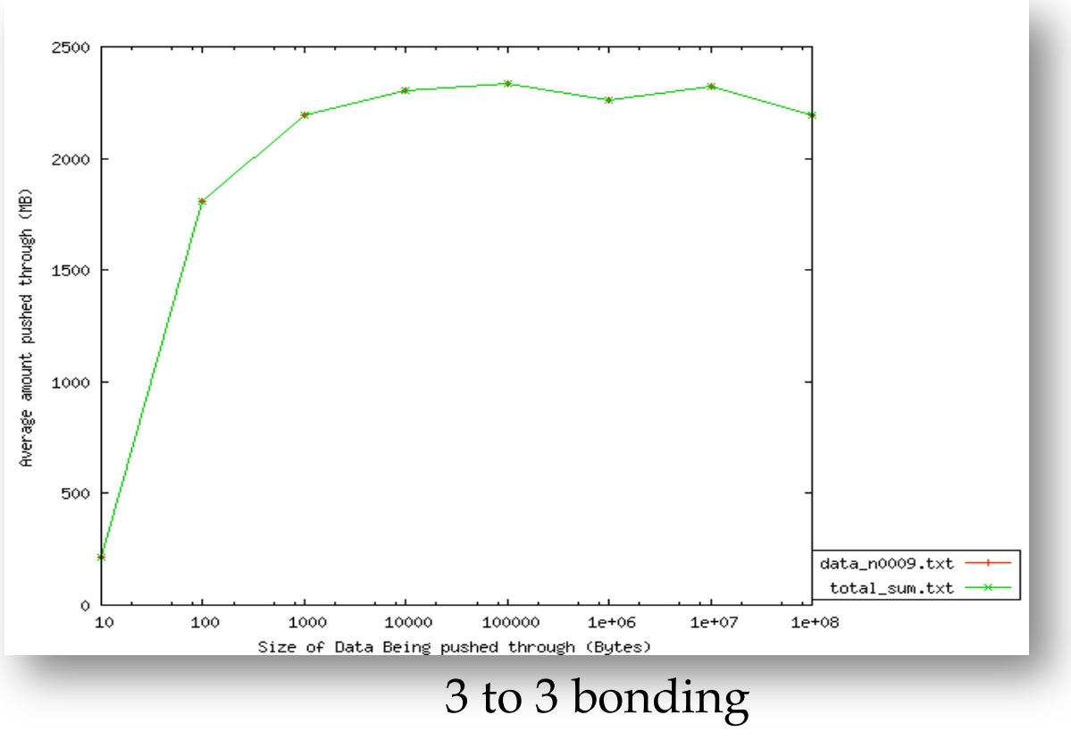
Actual results:
1 to 1 no bonding - 9.5 gigabit per second
3 to 3 bonding - 18.3 gigabit per second
4 to 4 bonding - 19.2 gigabit per second



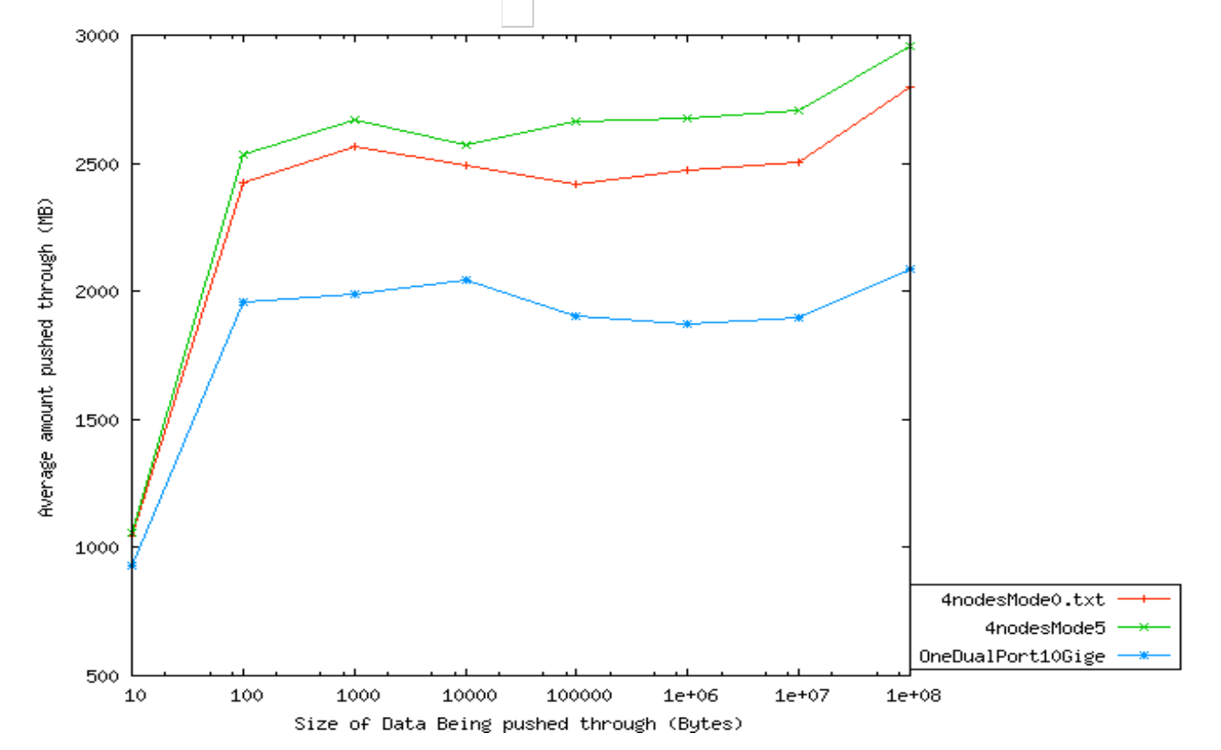
1 to 1



4 to 4 bonding



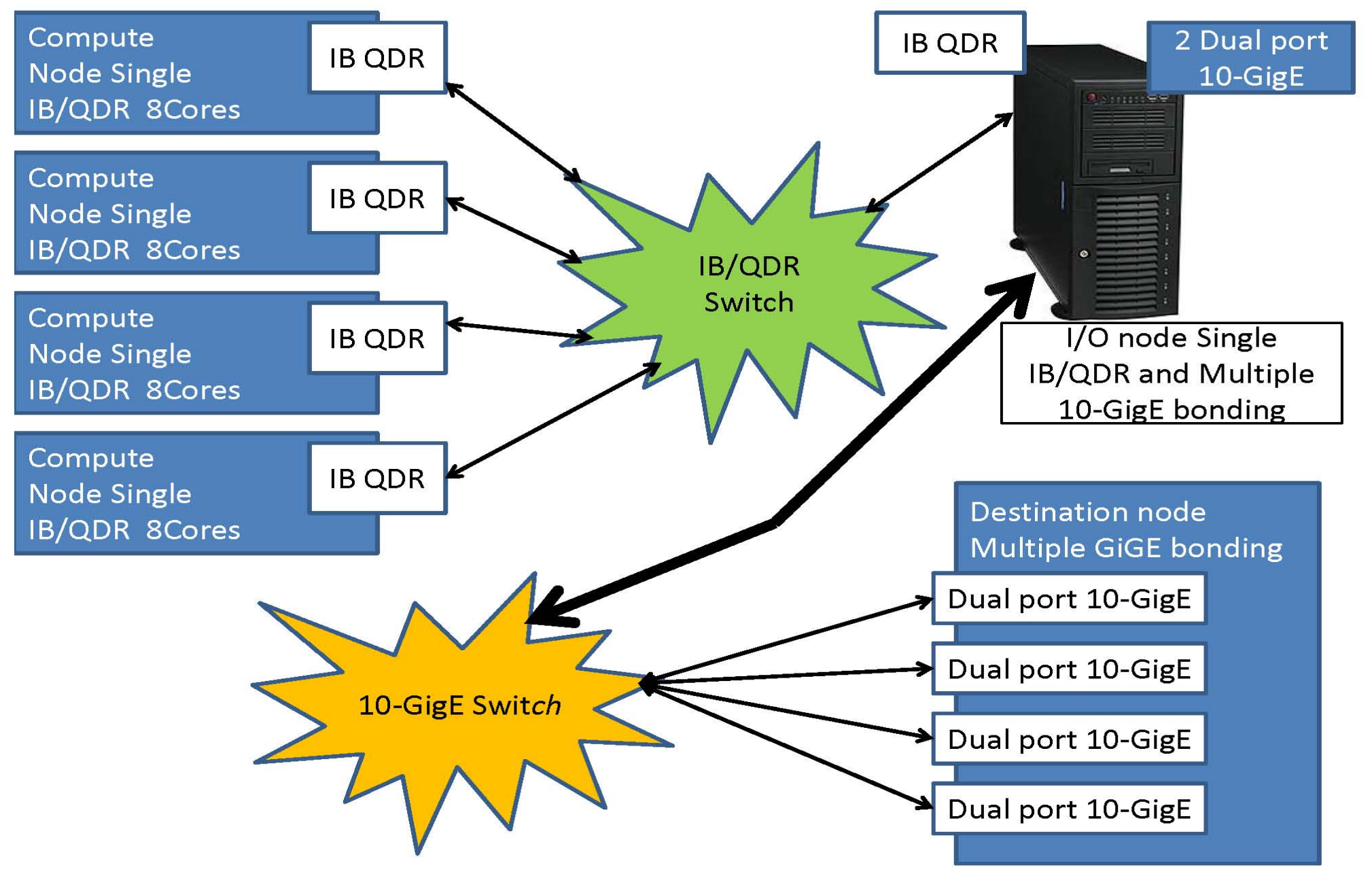
3 to 3 bonding



Mode 0 (Round Robin) and Mode 5 (Load Sharing) Performance

ConnectX
Single/Dual-Port Infiniband Adapter cards with PCI Express 2.0

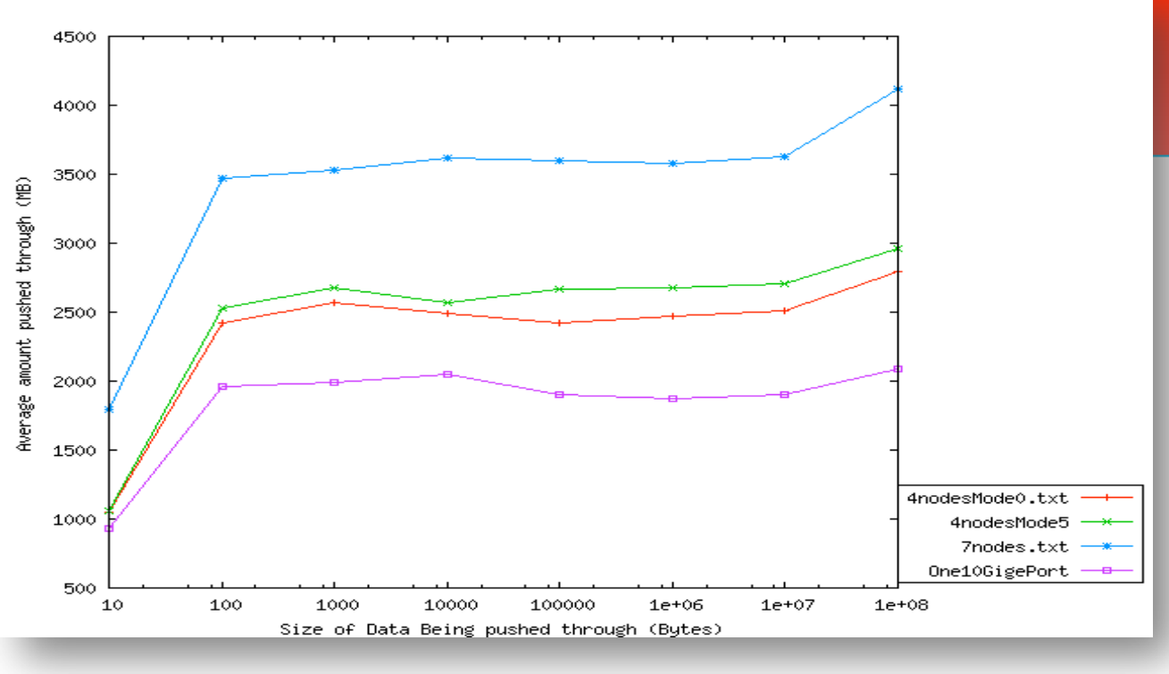
IB/QDR + Multiple 10-Gigabit bonding


Compute Node Single IB/QDR 8Cores
IB QDR
Compute Node Single IB/QDR 8Cores
IB QDR
Compute Node Single IB/QDR 8Cores
IB QDR
Compute Node Single IB/QDR 8Cores
IB QDR
IB/QDR Switch
IB QDR
2 Dual port 10-GigE
I/O node Single IB/QDR and Multiple 10-GigE bonding
10-GigE Switch
Destination node Multiple GiGE bonding
Dual port 10-GigE
Dual port 10-GigE
Dual port 10-GigE
Dual port 10-GigE

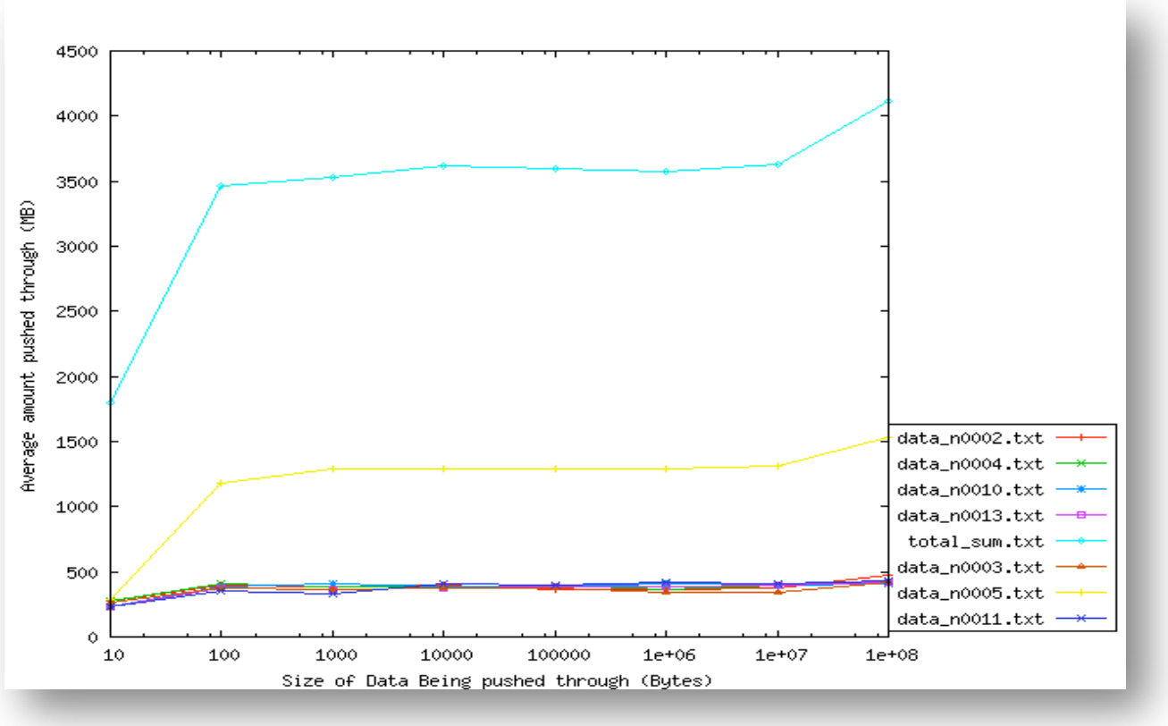
Set MTU to 65520 on the infiniband configuration.
Bond four 10-gigabit ports together.

Theoretical bandwidth performance – 40 gigabits per second
Physical bandwidth performance – 32 gigabits per second

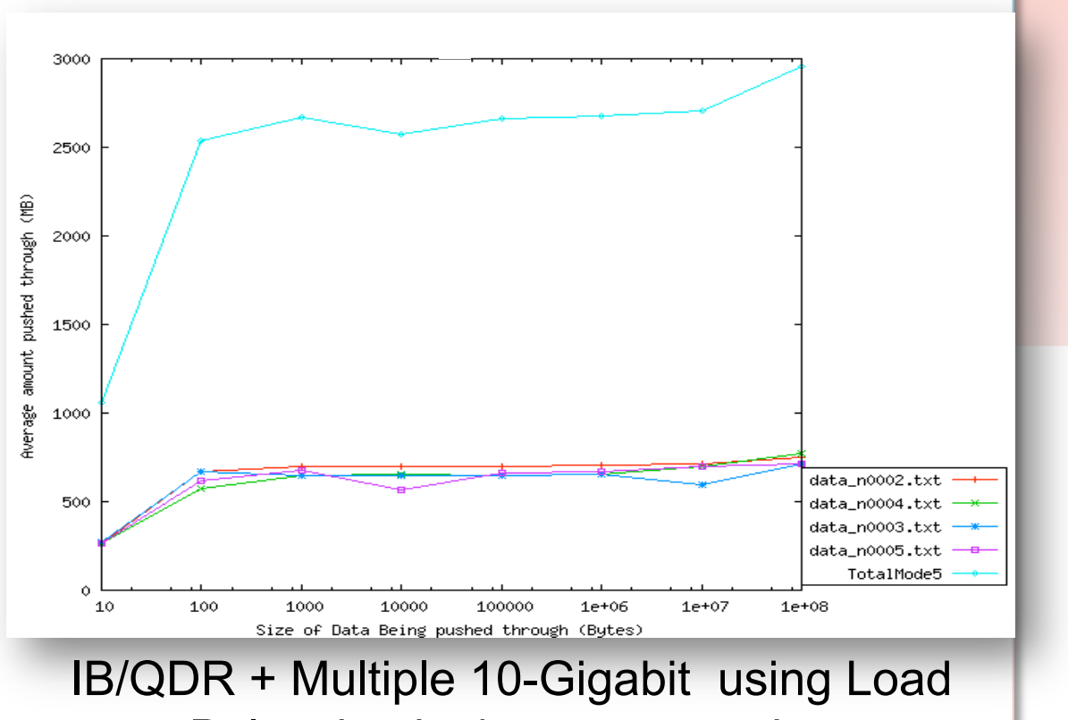
Actual results:
4 compute nodes – 24 gigabits per second
8 compute nodes – 28 gigabits per second



7 compute nodes , 4 compute nodes, and Dual Port 10-Gigabit card using Load Balancing



IB/QDR + Multiple 10-Gigabit using Load Balancing in 7 compute nodes



IB/QDR + Multiple 10-Gigabit using Load Balancing in 4 compute nodes

Conclusion

Our testing showed the bonding of 10-Gigabit ports will increase the bandwidth through a single I/O node and decrease the number of I/O nodes needed. This new configuration will enhance the performance and lower the cost of the PaScalBB infrastructure.

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